GRAIN RESEARCH LABORATORY

1988-1989 Report

75th Anniversary Issue

Canada

Canadian Grain Commission | Commission canadienne des grains

89-04992/

GRAIN RESEARCH LABORATORY
62nd Report : 1988 - 1989

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Dr. G.N. Irvine

Dr. W.F. Geddes

Dr. J.A. Anderson

Dr. F.J. Birchard

GRAIN RESEARCH LABORATORY
1988-89 REPORT

April 17, 1989

Canadian Grain Commission
Winnipeg, Manitoba

Commissioners:

I am pleased to submit the following report reviewing the activities of the Grain Research Laboratory for the period April 1, 1988 to March 31, 1989.

Respectfully,

K.H. TIPPLES
Director

INTRODUCTION

The year 1989 marks the Seventy-fifth Anniversary of the establishment of the Grain Research Laboratory, and in the body of this report will be found a chronology of major events since its inception, photographs of previous and current staff members and some reflections on the past by GRL alumni. We hope you will find these interesting.

The Grain Research Laboratory (GRL) functions under Section 12 of the Canada Grain Act (1971) according to which the Canadian Grain Commission shall *"... undertake ... research in relation to grain and grain products."* More specifically, all GRL programs today serve one or both of two basic objectives - **quality assurance** for Canadian grain and **market support**. Outlines of the year's activities are provided in this report.

The Analytical Development and Services Section lost two senior technologists during the year: Mr. William Podolak retired after 37 years' service, and we were saddened by the untimely death of Mrs. Patricia Starkey who passed away after a lengthy illness.

The Laboratory's permanent staff totalled 102 at March 31, 1989. In addition, 14 casual assistants were employed for varying periods throughout the year, as well as seven COSEP (career-oriented summer employment program) students.

Administration
Seated (L to R): Joyce Ramsay, Susan Weibe, Chris Cyr, Karen Tait, Evelyn Anderson. Standing (L to R): Nancy Morgan, Marvyn Lick, Nelson Barchuk, Carol Bunston, Ann Marie Robertson, Greg McLean.

GRAIN RESEARCH LABORATORY - 75 YEARS

From a very modest beginning in 1914 with a staff of two, the Grain Research Laboratory (GRL) has evolved into a modern, well-equipped research laboratory with a staff of about 100. In its 75 years of operation under five Directors, the Laboratory nas been a centre of excellence for cereal chemistry.

There is some question as to the actual date of the establishment of the Laboratory. The choice of 1989 as our 75th anniversary year is based on the following facts:

- In the first Annual Report of the Board of Grain Commissioners in 1912, the Board recommended that a laboratory be established in Winnipeg to evaluate the quality of wheat varieties and grades and to undertake moisture studies.
- In December 1913, Dr. F.J. Birchard was appointed the first Chief Chemist.
- In 1914 a suitable location was found on Main Street in North Winnipeg and the GRL was sufficiently well-equipped to commence operations by June 1914.
- It, therefore, seemed appropriate to choose late spring in 1989 as the time to celebrate the 75th anniversary. To this end, a series of open house activities are planned for the end of May.

Grain Research Laboratory Staff in the year 1944
Front row, seated (L to R): T.R. Aitken, J.A. Anderson, W.J. Eva

A partial view of post-WWII and 1950's GRL
Centre: applied wheat research - John Dempster
Counter-clockwise from left: baking laboratory - Harry Fisher;
Kjeldahl laboratory - Ralph Keating;
sample receival - Jack Waugh (seated);
data processing - Cecile Hartle; analytical laboratory - Iser Levi.

Chronology of the Grain Research Laboratory

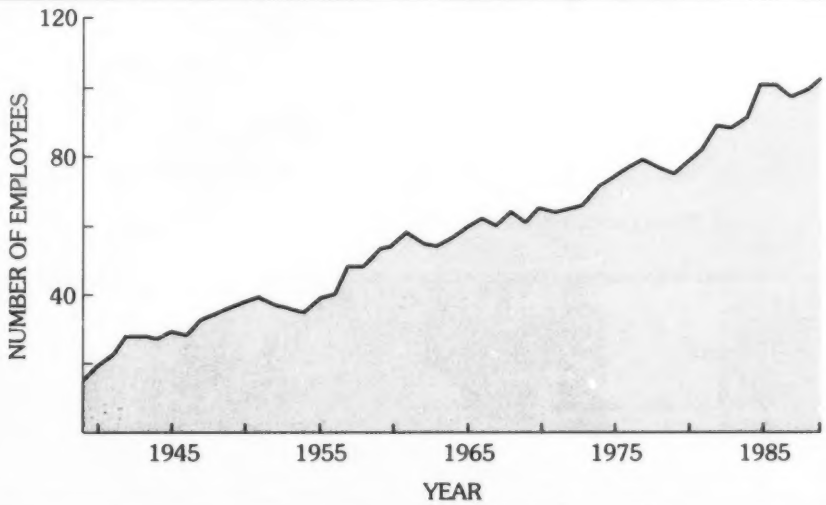
1913	The Board of Grain Commissioners, in its first Annual Report (1912), recommended the establishment of a Laboratory.
1913, December	First Chief Chemist, Dr. F.J. Birchard, appointed.
1914, January	Postal Station at Main Street and Magnus Avenue selected as the first site.
1914, June	Milling and baking equipment installed and Laboratory operation commenced.
1923	The Laboratory closed temporarily due to a dispute between Dr. Birchard and the Minister of Trade and Commerce. The Chief Chemist was apparently immune from dismissal and he remained the sole occupant of the Laboratory for several years.
1925	The Royal Grain Inquiry Commission advocated the establishment of a Research Laboratory under the supervision of the Board of Grain Commissioners.
1925	The revised Canada Grain Act (Section 79) laid down specific requirements for the operation of the Laboratory as part of the Board of Grain Commissioners.
1926	The Laboratory re-opened
1927	The Laboratory moved to the Grain Exchange Building, Lombard Avenue and Rorie Street.
1933, June	Dr. Birchard retired due to ill-health.
1933, October	Dr. W.F. Geddes appointed Chief Chemist.
1934	Laboratory facilities expanded with acquisition of a durum mill and macaroni-making equipment.
1938, November	Dr. Geddes resigned to become Professor of Biochemistry at the University of Minnesota.
1939, June	Dr. J.A. Anderson appointed Chief Chemist.
1942	Malting laboratory moved to the Grain Research Laboratory from the University of Manitoba.
1946-1950	Laboratory expansion continued with the hiring of chemists and acquisition of new equipment.
1957, June	First post-doctoral fellow, Dr. H. Matsumoto, began a year of study.
1962, November	Dr. J.A. Anderson resigned upon being appointed Director of the Canada Department of Agriculture Research Station, Winnipeg.
1963, January	Dr. G.N. Irvine appointed Director.
1973, June	Laboratory moved to its current location at 303 Main Street.
1978, December	Dr. G.N. Irvine retired.
1979, August	Dr. K.H. Tipples appointed Director.

Post-Doctoral Fellows

1957-58	H. Matsumoto
1958-59	A.H. Bloksma
1959-60	M.K. Narayanan
1960-61	M.K. Narayanan
1961-62	P. Meredith
1962-63	K.H. Tipples
1963-64	H.G. Muller
1964-65	P.C. Williams
1965-66	M. Doguchi
1968-69	S. Jelaca
1969-70	S. Jelaca
1972-73	J. Warchalewski
1973-74	J. Holas
1974-75	W.E. Liss
1975-76	K. Kim
1984-85	C. Lenoir
1986-87	H.-O. Kim
1987-88	M. Edney, X. Yin
1988-89	M. Hidvégi

Visiting Project Scientists

1966	T. Yasunaga
	K. Ikezoe
1967	D. Sparrow
1968	K. Tanaka
1970	T. Oda
1977	Y. Imaeda
1978	A. Fukuchi
1979	S. Nomura
1980	W. Kruis
1981	V. Casutt
1982	M. Fukuhara
1983	H. Shimizu
	H. Nakkoul
1984	P. Lenoir
	C.J. Hernandez
	E. A. MacGregor
1985	Wang de Fu
	Hau Tian Liang
	Xu Hui-Min
1986	C. Mayer
	A. Boudreau
1987	R. Niihara
1988	H. Kubota
1989	E.A.. MacGregor



Growth of GRL Staff: 1939 - 1989

THROUGH THE YEARS WITH GRL ALUMNI

J.A. Anderson, *PhD*
Director
GRL: 1939 - 1962

April 27, 1988
North Vancouver, B.C.

My congratulations to the Grain Research Laboratory on 75 years of valuable contributions to the welfare of the farmers and grain trade of Canada.

During my regime, we were able to build on the strong foundations laid by Drs. Birchard and Geddes. By the time I resigned, some 25 years ago, the staff, both scientists and especially the technicians, had developed a world class cereal research laboratory. Since then, it has moved for the first time to a building designed to house a laboratory, the staff has doubled in size, and with world wide travel by the staff the laboratory may well be the best known of all the national cereal laboratories. I am glad to have this opportunity of sending my congratulations.

When Dr. Bushuk resigned, a party was held in someone's basement. I had just returned from leave, came in late, and joined a group in spirited discussion. I think it was Bob Bettner who asked my opinion. They were arguing about whether the lab would run better without the scientists or the technicians. I immediately voted for keeping the technicians. The comprehensive records of the movement and quality of all grains, service to the Inspection Branch and the testing of milling and baking quality, macaroni-making quality, and malting quality, especially for plant breeders, would have been maintained without difficulty. And I think that much of the research in progress would have continued for some time.

Bob Bettner performing malt analyses in the mid-1940's.

But I doubt that this choice would have been sound for most laboratories. After the second NRC review committee, that distinguished Canadian scientist and administrator, Dr. W.H. Cook told me that we had by far the best group of technicians he had ever come across in visits to many laboratories of about our size. I admired not only their range of skills in developing equipment and technique, but also the way they collaborated and learned from each other. Their organizational and administrative abilities were also excellent. I expect that most of the ones I knew and admired have now retired.

Yes, we also had an excellent scientific staff. And I take some pride in the fact that so many of them obtained their PhD degrees while on leave of absence.

All the best to you and the rest of the present staff.

G.N. Irvine, *PhD*
GRL: 1945 - 1978
Director: 1963 - 1978

November 29, 1988
Victoria, B.C.

Greetings on your 75th Anniversary! I joined the staff in year 31, a time when the lab and the Winnipeg Grain Exchange were populated with a number of real characters who helped to make life really interesting. There was, for example, Bobby Moore, a "Remittance Man". Dressed rather shabbily, he would walk into your office or lab uninvited and unannounced with an old fedora on his balding head and an ancient leather portfolio under his left arm. First off would be a few obscene phrases just to get your attention, then he would be off detailing his latest scheme to dam up the Red and Assiniboine Rivers and make Winnipeg the Seaport of the West. Or his Manorial Settlement, a back-to-the-land scheme, newly worked to adapt it for acceptance under the newly proclaimed Veteran's Land Act. No one was sacred where Bobby was concerned, not even the provincial Premier. There was also Major Strange, an Englishman who had come out to homestead after the first World War. He was the great expert on farming, the grain trade and you name it, and wrote a monthly newsletter for the Searle Grain Co.; he was also in charge of their research department. The Major was quite a gadfly, brusk and rather haughty when he might choose to drop in and consult you in an area where he would grudgingly concede you might be the expert. The Chief Chemists and the Chief Inspectors back then were all larger than life and operated their fiefdoms with an iron hand. Then a PhD was a pretty rare thing, and was considered rather awesome by the majority of the Commission's staff. The Chief Chemist was the only PhD on the lab staff in 1945 but the early post-WW 2 period changed all that for good. The technicians in those days had remarkable skills, some of them, and built much of the equipment that was used in the lab. There was one who swore that he ground lenses for the telescopes of the Dominion Observatory from the bottoms of Coke bottles, as a hobby at home!

W.O.S. Meredith, *PhD*
GRL: 1942 - 1974

October 5, 1988
Saskatoon, SK

Greetings to the Grain Research Laboratory.
As one of the elders of the former staff of the laboratory, I join in the celebrations of the Jubilee by wishing much future success and happiness to the staff that will continue to the centenary. The reputation of the laboratory has depended on the strength of the technical and professional staff. They have created a reputation for authority and knowledge in all its fields and for service to Canada that is shared world wide and respected. Just continue on the foundations that have been laid.

Beginning of Paper Chromatography
I had been introduced to paper chromatography while at the University of Minnesota in 1947-48, just as the procedures were being developed. Later on my return, Dr. Anderson asked several times about such procedures and when they might be used in the laboratory. I avoided such practices in the current stage of the laboratory and the facilities. Under some pressure, a run in the laboratory, which was adjacent to Dr. Anderson's office, was set up using a large dessicator, pyridine, ethyl acetate and water as solvent. This was made over a weekend. When Dr. Anderson came in on Monday morning he was considerably upset by the odours - such procedures must cease immediately. So, better facilities were developed upon approval: screened areas, fumehoods, drying cabinet, chromatographic cabinets on dollies - most of them built by Ted Reichert. Thus science advanced.

Preparation for Standards Board
Dr. Anderson came to the Grain Research Laboratory with a good background in agriculture and in cereal research. He was an expert in chemical analysis and had an excellent grasp of the principles of experimental design and interpretation of data. The scope of the laboratory's involvement in the Standards Board meeting impressed him and he set out to impress the Board.

The Inspection Branch sent down type samples, preliminary and final samples in succession. These were processed and compared with the previous crop, as well as the protein survey results and the composites. The entire staff set about carrying out the various determinations, in long hours. Determinations not used for some time were practised - gassing power, maltose values, gluten washing on flours, carotene and discs on durum semolina, oil content and iodine value on flax, etc. The flax determinations were difficult and messy, using reagents that would not be permitted nowadays on account of hazards to health. When the sets of data were accumulated and compared, Dr. Anderson set them in table form in the short time available. Then the staff, many wives included, set to putting the data on large sheets of brown paper to show at the Standards Meeting, to hang on easels as needed. This was before slides came into being. One of the Standards Board members from Creston always brought a few boxes of apples to the meeting, and as it progressed the staff relaxed and each was

rewarded with an apple obtained by discrete and cautious handling from upstairs.

Identification of Barley and Malt Gums

The now classic series of papers on varietal differences in barleys and malts showed that wort viscosity represented some part of malt modification and some other relations with malt extract and nitrogen. I made some studies on protein modification and solubility during malting and mashing, with interesting but not conclusive results. Mashes were made at various temperatures and alcohol solubie nitrogen of worts were determined in the studies. This work was suspended while I attended the University of Minnesota in Dr. Geddes's department. He did some work with Dr. Fred Smith, an outstanding carbohydrate chemist from Birmingham, on plant gums. On returning I realized that the alcohol treatment of wort was identical to that I used in precipitation of plant gum from solution.

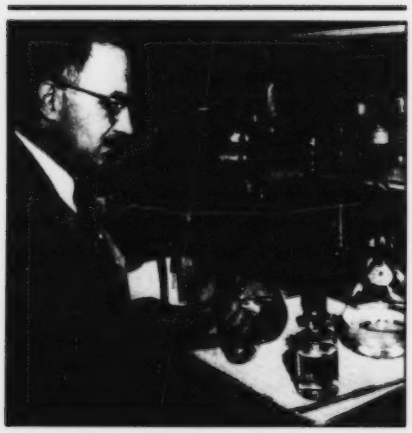
The mashing experiments were repeated at increasing mashing temperatures and viscosity of wort was measured. The precipitates from alcohol treatment were recovered, washed and redissolved in water. The viscosities tracked those of the original worts that increased with mashing temperature.

Eddy Bass had joined the staff by then and he along with Bob Bettner and Vic Bendelow set out to learn more about this precipitate. Bass tried various enzymes on the solutions, and curiously, an alpha-amylase preparation used in barley extract determination reduced viscosity, even if the alpha-amylase was inactivated. Thus it contained another enzyme, named X by Bass.

I re-examined the old data on variety viscosity and carried out more statistical treatments. Between varieties, wort vicosity exhibited in multiple regression analysis a positive correlation with barley extract and a negative correlation with malt extract, with the coefficients being equal and opposite in sign. Thus viscosity was related to a difference between barley and malt extract, that is, to something that had no physical presence. The precipitate was dissolved in alkali and had a negative rotation of polarized light, typical of a beta-linked carbohydrate. It showed carbohydrate on hydrolysis.

Curiously, the three identifications (enzyme, polarization and positive carbohydrate) were completed on a single afternoon - along with the statistical analysis. Dr. Hlynka commented this was the first carbohydrate to be isolated by statistics.

The material later isolated from barley was sent to Dr. Fred Smith who with his student Ken Gilles, showed that it was a beta linked carbohydrate with 1:3 and 1:4 linkages. Thus, the now well-studied barley gum field of study was started, along with complementary studies by the Heriott-Watt group in Edinburgh under Professor Preece who had used different routes in his work. These cereal constituents, now known as beta-glucans, are receiving much attention in nutrition and medicine.



Dr. Meredith working in his laboratory in about the year 1950.

V.G. Martens
GRL: 1940 - 1964

October 22, 1988
Winnipeg, MB

A Tribute to Dr. J.A. Anderson

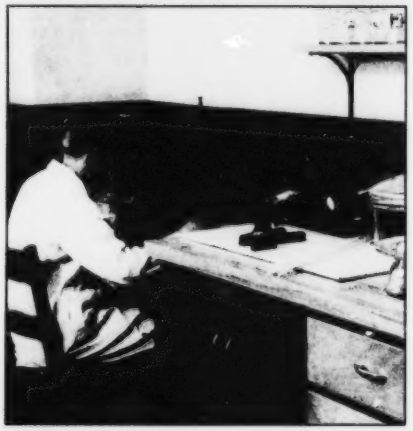
It is a pleasure for me to have this opportunity of extending congratulations on the 75th anniversary of the Grain Research Laboratory. Twenty-four years of my working life were spent with this institution. During most of this time, Dr. J.A. Anderson was the Chief Chemist and Director of the Laboratory. Under his leadership a world class laboratory was developed which has provided exemplary service to Canada's grain industry and is recognized as a leading cereal research institute throughout the world. Dr. Anderson's contribution to Canada's grain industry and to the scientific community is recognized by his many publications and lectures and by the awards and honorary degrees which he has received.

In this brief writing I would like to pay tribute to Dr. Anderson, not for his achievements as a scientist, but for the opportunity he provided for career development for many technicians in the Grain Research Laboratory. We spent many happy fruitful years working in the Laboratory. For people to be able to spend a large part of their life in a satisfying working environment is a privilege indeed. For the most part, this was the case for the technical staff.

Dr. Anderson cared for each one of us and we were given much opportunity to develop our individual skills. We were frequently moved from one section of the Laboratory to another in order that we could acquire a better knowledge and appreciation of the total operation. Amongst the staff there was a sharing of knowledge and skills and a working together to solve the many problems that came with new challenges that always seemed to be before us. During the war years and sometime thereafter, Laboratory furnishings and scientific equipment were not readily available. Accordingly, there was a requirement and an opportunity for much innovation. Eventually our aggregate knowledge and skills were such that there was very little that we could not service, process or construct in the Laboratory.

There were many reasons for Dr. Anderson's success with the technical staff: his recruiting policy, his personal involvement with individuals, and his ability to continually provide new challenges. He almost always took part in the hiring process of technicians. In fact, he had such a good track record that the Manitoba Civil Service Commissioner would often seek his advice and help in recruiting staff and in promotional competitions for other government laboratories.

One of the more amusing aspects of Dr. Anderson's tests for job applicants was the requirement to take apart and re-assemble an old fashioned door lock with its various springs, levers and latch.There was success and failure, but it was always amazing how much information could be obtained about an individual by such a simple exercise. As part of the selection process this test was also used when the Laboratory hired its first female technicians in the mid-forties. As a



group they did rather well in such tests and most became excellent technicians.

Dr. Anderson's attitude toward the technical staff also had a positive influence on the professional staff of the Laboratory. Scientists and technicians worked well together and for the most part the technicians were held in high esteem by the professionals.

After the war, Dr. Anderson travelled to many countries of the world to re-establish contact with cereal scientists and to seek out market potential for Canadian grain. This was before world travel became commonplace and before the advent of television. Dr. Anderson was always willing to share his experiences. He was a great raconteur and a good photographer. His lectures and slide presentations were much appreciated by staff members and spouses.

During Dr. Anderson's regime many technicians made significant contributions to the Laboratory. To name but a few - Harold Rasmussen, who developed the circuit for the 919 Moisture Meter; Hugh Black, an expert in experimental milling; Henry Kilborn, a specialist in experimental baking and dough rheology; the late Bob Bettner, who designed and developed a wide range of testing equipment for malting barley; Ken Rerie, a craftsman extraordinaire, who developed great skill in design and construction of Laboratory furnishings and equipment. I had the good fortune of working both as a technician and as an administrator in the Laboratory, later as Secretary and Director of Administration for the Commission and then as Executive Director for the Canadian International Grains Institute.

Our success as a group of technicians was largely due to the vision and leadership of one man, Dr. J.A. Anderson. Accordingly, it is fitting that we pay tribute to him on this the 75th anniversary of the Grain Research Laboratory.

The Grain Research Laboratory ca. 1950
Top: Hugh Black performing laboratory-scale milling.
Middle: Henry Kilborn doing wet chemistry.
Lower: Ken Rerie using an analytical-class balance of the day.

W. Bushuk, *PhD*
GRL: 1953 - 1962,
1964 - 1968

August 30, 1988
Winnipeg, MB

On the occasion of the 75th Anniversary of the Grain Research Laboratory, I extend to you and your colleagues sincere congratulations for a job well done. The high reputation that Canadian grains have at home and abroad derives largely from the outstanding research and vigilant quality control carried out by the Laboratory staff. Best wishes for continued success.

Photo credit: University of Manitoba

E.J. Bass, *PhD*
GRL: 1949 - 1960

November 22, 1988
Winnipeg, MB

Some GRL Anecdotes of the Fifties

As this is being written (1988), it is hard to believe that 40 years have elapsed since I first set foot in the GRL, Grain Exchange Building. The post-war (WWII) era was a period of transition from a depression-induced thrifty and conservative (not politically) autocratic administration to the present age of mega-buck budgets and participative management. I like to believe, however, that the essential elements of creativity and dedication to the public service have not changed in the intervening years. Moreover, I am certain that the fun of working at the GRL has changed little, and to this end I contribute the following anecdotes to the 75-year history of the Laboratory. Although the passage of time may have dulled my recollection of some of the minor details, the stories are (hopefully) accurate enough to merit inclusion in this history.

The Case of the Disappearing Coffee Cream

In the early days of the Laboratory in the Grain Exchange Building and peaking in the fifties, technicians were encouraged and trained to become skilled jacks-of-all-trades: carpenters, electricians, plumbers, glass-blowers, photographers - in addition to indispensable assistants to the research scientists. One of the most versatile member of this remarkable group was Ted Reichert, to whom is credited the execution, if not the complete design as well, of the high-tech scheme to solve the case of the disappearing coffee cream.

In those days, as today, the refrigerator was a standard piece of Laboratory equipment. Then, as now, all kinds of goodies could be found in the refrigerator that were not necessarily related to the pursuit of basic research. In those days preceding coffee whiteners and cholesterol, thick and rich coffee cream was a luxurious refrigerator item. Small wonder, then, that the daily disappearance of small, but measurable, quantities of coffee cream from one of the refrigerators was cause for concern. It was generally agreed (an expression intensely disliked by Dr. Hlynka) that something must be done to bring the thief to justice. Yes, then, even as now, the coffee break was a sacred trust and any threat to its existence, no matter how minor, was quite unthinkable. But what to do?

Well, I won't bore you with all the schemes suggested and discarded. Let's just pick up the action at the point where it was generally agreed (sorry Dr. Hlynka!) that the culprit must have been one of the cleaning staff and that the thefts were occurring some time between 5:00 p.m. (usually much later, because there was always someone working late virtually every day, especially in the barley lab) and midnight. So Ted and his cohorts rigged up a camera with infra-red illumination, both simultaneously triggered by a switch on the refrigerator door. Nothing could have been sneakier or more effective!

Tests showed that the culprit could not prevent the mechanism from firing, and secrecy was assured by the I.R. flash which could not be seen even in complete

Photo credit: Canadian International Grains Institute

darkness. We had not long to wait. The very next morning, we found the flash fired, and could hardly contain ourselves to view the developed film. The result was spectacular. There was a perfect picture of the refrigerator door open, a hand clutching the bottle (yes, bottle) of coffee cream, and unmistakable face (totally innocent in appearance) of the dear old lady who was the friendliest of the cleaning crew!

So, the crime was solved, but then came another problem - to punish or not to punish. Again, interminable discussion and soul-searching. Finally, it was generally agreed (can't seem to avoid it) that punishment was not required, only deterrence. This was achieved by pasting a print of the incriminating picture on the inside of the refrigerator door, and the case of the disappearing coffee cream was not only solved but also terminated.

The Case of the Mysterious Goldfish

The telling of this tale may still be premature because there may yet be some mystery attached to it which might better remain a secret. But what the heck, it was a classic spoof, and its perpetrators may now, alas, be beyond the reach of its victim. So here goes.

Chromatography had just made its appearance on the scientific scene and paper chromatography in particular seemed to offer an elegant technique for characterizing barley gums. Dr. Meredith was quick to recognize the potential of paper chromatography in his studies and, as it turned out a year or so later, thanks to Bill's earlier studies, I was able to characterize gum-degrading enzymes by the order of appearance of their reaction products by one-dimensional paper chromatography. At any rate, in the absence of standard equipment for such a novel technique, Bill assembled his own. With no idea of ideal dimensions, Bill did the obvious ... he bought the largest, tallest, widest, thickest cylindrical glass tank that ever sat on top of a bench. This thing was so big Bill had to use a step stool to load it. The filter paper that you suspended from the Bettner-built stainless steel trough secured inside the tank by a stainless steel band was large enough to be a single-bed sheet. And the enormous lid that sealed this behemoth for action had to be raised and lowered by a 3-pulley hoist suspended from the ceiling. Okay, so this is a little exaggerated, but you had to see this thing to appreciate its immensity ... particularly those of you who today use those matchbox-size HPLC cells (is my obsolescence showing?). Needless to say, Bill Meredith established his sovereignty over his new domain immediately, with dire warnings that no one, but no one, was to even think of approaching, let alone touching, this device without his express written consent. Well, that was simply too great a challenge for one irascible prankster. The rascal had the gall, during the very first lunch hour that the sparkling new monstrosity was unattended, to fill the tank with water and release into its gaping interior two tiny perfectly matched and extremely mobile goldfish! To this day, Bill Meredith is not completely sure of the identity of the perpetrator of this heinous crime. The secret has left this vale of tears with the mortal remains of our dearly beloved Bob Bettner. Bob, if there really is a big wonderful barley lab up there in the sky, what irreverent pranks are you preparing for our arrival?

Dr. Meredith examining the results of a paper chromatography run.

Fred Kuzina
GRL: 1948 - 1984

October 28, 1988
Winnipeg, MB

It was during the period between the late fifties and early sixties that the Basic Wheat Research section was keenly interested in the effect of such chemicals as iodate, bromate, N-ethylmaleimide and others on the properties of wheat gluten. Dr. Hlynka and I were involved in the study of dough rheology and I had spent considerable time in washing out gluten from batters and doughs. I can remember that there was a lot of interest in the different physical properties of gluten and in the development of various methods to measure these properties. On this particular day I had washed out a fair-sized lump of gluten, still wet with water dripping through my fingers. I recall coming out of the dough room into the large lab towards my desk. Nearby, Bob McLeod and Bob Matsuo were engaged in some discussion. I had told them that the gluten in my hands was washed out from a dough to which I had added sodium bisulfite which made the gluten very sticky and extensible. One of us had suggested a rapid and simple test for measuring stickiness and extensibility of gluten. The test was to squeeze most of the water out of the gluten until it became somewhat sticky to the fingers and then throw it up to the ceiling. The main feature of the test was to measure the length of the gluten strand and also the length of time it would stick to the ceiling before falling to the floor. With a timer set, the three of us were observing the gluten being stuck to the ceiling. Our Director, Dr. Anderson, walked in from the adjacent lab, stopped for one moment, looked at the three of us observing the lump of gluten stuck to the ceiling, and without making any comments carried on into the next lab. One can only imagine somewhat of an embarrassing moment that the three of us experienced. There was no doubt in our minds that this method would not be published in any journal. When trying to remove the gluten some of the paint came off the ceiling. A few years later Mr. Pocklington, the building manager, decided to have the labs repainted and that spot was finally covered.

Dr. Hlynka in the middle of an alveograph determination - a test for gluten strength and extensibility.

It was in the late forties during which time Dr. Hlynka and Bob Cheale were experimenting with the preparation of gliadin using ethanol. During the initial stages of the test the results appeared to be quite encouraging, but later Bob could not reproduce his results. Dr. Hlynka decided to closely supervise these tests and for some time they could not get any satisfactory results. With the exception of the ethanol which was contained in a one litre stoppered bottle, they had tested all other variables. Finally they decided to test the ethanol and found that it was not the concentration which they had assumed it to have been. Without going into detail they had discovered that the janitorial staff had been drinking some of the alcohol from the bottle and adding water to bring it up to the original level. This of course kept diluting the concentration of the alcohol and resulted in the non-reproducibility of the test. From that period on, as many of us remember, all bottles containing ethanol were labelled ETOH.

Hiroshi Matsumoto, *PhD*
Post-Doctorate Fellow
1957 - 1958

December 7, 1988
Osaka, Japan

Allow me to give you a glimpse of the Grain Research Laboratory of 30 years ago through the eyes of the first Post-Doctoral Fellow.

After a long trip of 17 hours on a propeller plane with a refuelling stop at Anchorage, I set foot in Canada at Vancouver. After another long trip by rail, I finally reached Winnipeg where I was met by Dr. Hlynka at the CPR Station.

I can still picture the entrance to the GRL at 886 Grain Exchange Building. On the door was a sign, "Chief Chemist - J.A. Anderson".

Dr. Anderson welcomed me and asked me to sign the visitors' book. My signature is still among the pages of the book. It was a glorious era for Dr. Anderson as he was awarded the Osborne Medal in 1957.

As soon as I got into Dr. Hlynka's office he asked me about my work in Japan. In his customary manner of slowly pacing back and forth in front of his blackboard, he talked to me. These were golden years (1953-1958) for him as well as he had launched a program of research on structural relaxation of dough. A cereal chemist back in Japan, Dr. Ichiba of Nisshin Flour Mills, asked to find out how Dr. Hlynka managed to carry out such a great number of experiments with a flour which we presumed would change in characteristics in a short time. Were all his staff experimenting all day and night? I wrote back that the answer was simple: flours were stored at -20°C. They had regular coffee breaks at 10:00 a.m. and 3:00 p.m. with a long lunch period. Everyone had a long vacation during summer. There was no difference in the hours of work compared to others; the difference was in the thoroughness with which the project was done and in the theoretical interpretation of the results. On the basis of this work in dough rheology, Dr. Hlynka was awarded the Osborne Medal in 1976 at the Annual AACC meeting in New Orleans. I was fortunately there to witness the presentation.

Dr. Irvine in the mid-1950's.

After awhile a young man appeared, hands in his trouser pockets, humming a tune. "Ikaga desu ka Matsumoto-san?" Who else but Norm Irvine greeting me in rudimentary Japanese. I had met him when he visited Japan six months earlier. Oh! look at another young man coming into the room singing a song, "Oh Baby". That was Walter Bushuk. I thought: How nice a father he must be to be singing about his own baby! But ..... We were in the same laboratory but Walter left for France to begin his studies as a Post-Doctoral Fellow. However, before he left, he was kind enough to build a platinum electrode with his skill in

glass blowing for my work on amperometric titration.

"Masumoto-san, dō deska?" Another greeting in Japanese came from a smiling Bob Matsuo. After a month at the YMCA I moved to his home and enjoyed his parents' hospitality for the rest of the year.

Congratulations on your 75th aniversary. I would like to express my hearty appreciation to those at the GRL who helped me in my research and made my daily life enjoyable.

OBJECTIVES AND OPERATIONS

As mentioned earlier in this report, the Grain Research Laboratory has a mandate to undertake research in relation to grain and grain products. This research, and associated functions, addresses one or both of two major objectives: **quality assurance** and **market support** for Canadian grain.

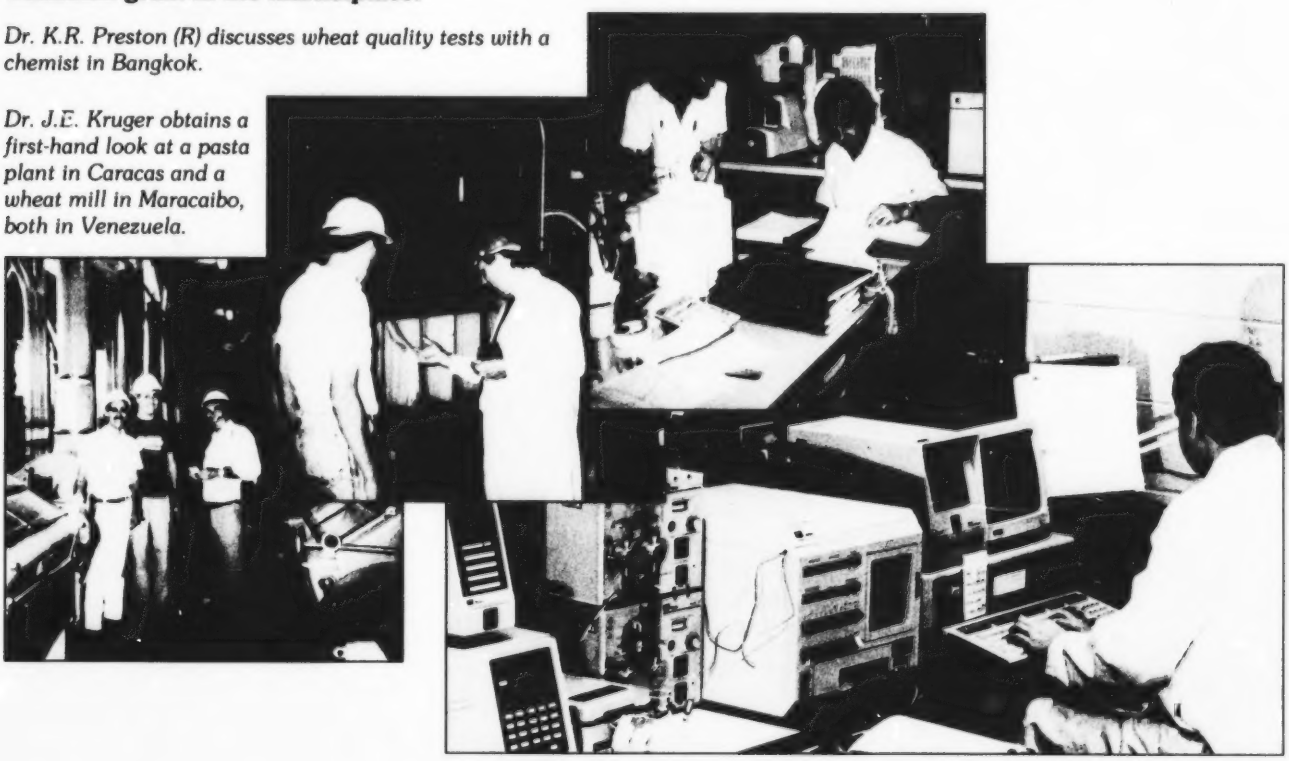
The many activities comprising GRL operations may be broadly categorized as research, related scientific activities and provision of scientific and technical expertise - all of which are interrelated. *Research* is necessary to enable us to better define quality and develop new and improved methods of measuring it. *Related scientific activities* involve such programs as harvest surveys, cargo and carlot monitoring and cultivar evaluation. *Scientific and technical expertise* is essential if we are to provide appropriate advice to the Canadian Grain Commission (for responding to quality-related questions on Canadian grain) and service support to the Commission's Grain Inspection Division (for the calibration and monitoring of instruments currently used in the operational testing of grain, for development of more rapid instrumental methods for quality analysis and for determining and documenting the effects of degrading factors on the end-use quality of Canadian grains).

Detailed summaries of these activities for 1988-89 are provided in the pages that follow.

Technical missions to current or potential customer nations are vital for maintaining the high reputation of Canadian grain in the marketplace.

Dr. K.R. Preston (R) discusses wheat quality tests with a chemist in Bangkok.

Dr. J.E. Kruger obtains a first-hand look at a pasta plant in Caracas and a wheat mill in Maracaibo, both in Venezuela.



State-of-the-art apparatus and techniques help to achieve accurate and timely analyses in support of quality assurance.

QUALITY ASSURANCE ACTIVITIES

Cargo and Carlot Monitoring

All export cargo shipments of wheat, barley, oats, rye, canola, corn and soybeans involving 1,682 cargoes for the 1987/88 crop year were screened to confirm freedom from contamination by pesticide residues. Selected cargo loadings of wheat, barley, corn and soybeans involving 294 shipments for the 1987/88 crop year were also screened for the presence of mycotoxins. In addition, selected cargo loadings of wheat and barley were monitored for the presence of phosphine.

A weed seed monitoring program has been instituted and will include analysis of every grain shipment to certain foreign destinations and analysis of both a sampling of carlot terminal deliveries to determine the geographic distribution of contentious species, and also a sampling of the "foreign material" grading component of export cargoes to determine the frequency of occurrence of specific weed seeds.

Monitoring of bi-weekly composites of wheat unloaded at terminal elevators was continued, using the Falling Number test, to indicate any evidence of sprout damage. This allowed confirmation of locations which were the origin of wheat exhibiting high alpha-amylase activity. Monitoring for the presence of toxin-producing *Fusaria* molds was undertaken for selected wheat carlots identified as containing "tombstone" kernels.

Export cargo samples of canola continue to be monitored for several quality factors - including oil and protein content, fatty acid composition and chlorophyll level.

Residue Analysis
Seated (L to R): Janyce Thorsteinson, Audrey Holmberg.
Standing (L to R): Don Gaba, Wes Harnden, Tom Nowicki.

Technical Services

The Grain Research Laboratory is responsible for the monitoring of the performance and calibration of the Model 919/3.5 moisture meters used by the Inspection Division of the Canadian Grain Commission (CGC) in the official grading of grain. Effective August 1988, an updated conversion table for use with these meters was issued for Canadian flaxseed. There are currently 29 conversion tables in effect for 23 types and classes of grains and oilseeds. The performance of Model 919 meters in CGC offices across Canada is monitored through the use of bi-weekly check test samples. Meters not functioning satisfactorily are recalled for servicing.

Since the relation between meter reading and moisture content is influenced by factors such as seed size and density, calibration equations used to generate the conversion tables must be continually tested for relevancy and updated as necessary. This calibration work requires analysis of many hundreds of samples of various grains over a wide range of moisture content, and recently has involved expenditure of a great deal of time and effort on Eastern Canadian corn largely because meters using the principle of capacitance measurement function less accurately and consistently for larger, irregularly-shaped seeds such as corn than for small-seeded grains.

Technical services, provided to the Grain Inspection Division of the CGC, for analysis of grain parcels suspected of contamination by seed treatment pesticides resulted in action being taken against 41 carlots in the crop year ending July 31, 1988.

The GRL also provides confirmatory services for the identification of registered Canadian wheat varieties by chemical analysis of samples submitted by the Grain Inspection Division. This year testing was requested for 134 carlot samples, 8 cargo composite samples and 43 miscellaneous samples - resulting in a total of 13,545 individual kernel analyses.

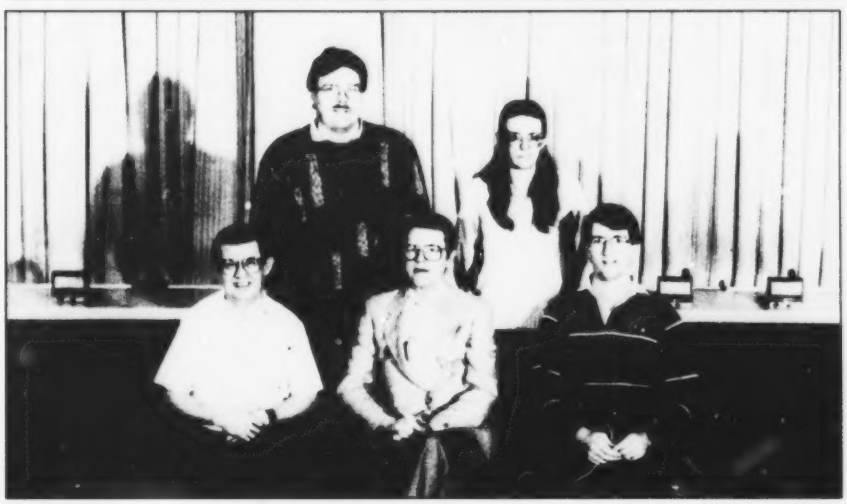
Other technical services include quality testing of samples submitted by various segments of the grain industry through the Grain Inspection Division of the CGC. Examples are: testing for possible quality damage due to improper use of artificial drying for grain, testing for alpha-amylase activity and testing for germination energy.

Cultivar Evaluation

As a result of increased emphasis on marketing of wheat of classes other than the predominant Canada Western Red Spring and Canada Western Amber Durum, end-product evaluation of lines entered in the various Co-operative Tests has increased dramatically. There are now six Co-op Test series (up from two in 1977) with the split of the bread wheat series into two (a central and a western series) in 1978 and the addition, in 1986, of a high-yield series (aimed primarily at the Canada Prairie Spring class), a Parkland series (aimed at spring wheats suitable for the Parkland area) and a soft white spring wheat series. Not only have the number of cultivars to be tested increased, the number of different types of end-use quality tests has increased as well - reflecting the different products for which the wheat from the various classes is intended.

The Grain Research Laboratory continued to provide essential quality evaluation support at the micro-malting and pilot-malting stages for Canadian malting barley variety development programs. Consequently, in 1988 two promising two-rowed malting barley selections, TR479 and TR490, advanced from laboratory-scale testing and were each grown under interim registration by approximately 20 producers under contract to the Canadian Wheat Board for purchase and plant-scale testing by domestic malting and brewing companies. This final stage of commercial evaluation will determine whether these selections are given permanent registration. A two-rowed malting cultivar developed in the USA, TR930, was approved for interim registration.

Two six-rowed malting cultivars having white aleurones, BT447 and BT922, have been approved for interim registration, and will be advanced to plant-scale commercial testing during the 1989 and 1990 crop years. These selections are visually indistinguishable from several six-rowed feed barleys; therefore special handling procedures would be required to preserve the identity of these selections in commercial channels.



Malting Barley Applied Research
Seated (L to R): Art Mitchelson, Don LaBerge, Jim Bethune.
Standing: Dennis Langrell, Maureen Stethem.

Grading Factor Studies

A major emphasis this year was a study into the structure and protein composition of vitreous, piebald and starchy durum wheat kernels. Vitreous kernels, as expected, were higher in protein content and harder than starchy kernels which were, nevertheless, as hard as the hardest common wheat kernels. Despite striking differences in the microscopic structure of starchy and vitreous zones within the endosperm of piebald kernels, the two zones were similar in protein content and protein composition.

Following the occurrence of hot dry growing conditions in Southern Ontario in 1988 and reports from the United States suggesting a strong relationship between drought stress and aflatoxin production, a special survey was carried out to confirm the absence of aflatoxin from 1988-grown Ontario corn. Due to continuing interest in levels of *Fusarium* trichothecene toxins in Eastern Canadian white winter wheat, a study was launched to test composites of weekly deliveries to terminal elevators for these mycotoxins. A survey of elevators in Southern Ontario was also carried out in collaboration with Agriculture Canada's Food Production and Inspection Branch to confirm the absence of residues of carbon tetrachloride from samples of Canada Eastern white winter wheat.

Results from a study into the effects of frost damage on Canada Western Red Spring wheat quality indicate that frost has a minimal effect on quality of wheat at maturity levels corresponding to a seed moisture content of less than 45%. Above this moisture level, the effect of frost damage becomes very pronounced.

Calibrations have been developed for the determination of protein, oil and moisture in soybeans by near-infrared reflectance (NIR) and transmittance (NIT). The soybean originated in Ontario, and calibrations were developed for the DICKEY-john GAC III NIR, and Tecator Infratec Model 1225 NIT instruments. The Infratec gave the better results overall (including moisture), due to its capability of utilizing more wavelengths. Research is continuing on updating DICKEY-john calibrations, using four extra filters to improve the accuracy of analysis of both oil and protein.

A new method for the assay of alpha-amylase activity in cereals (Ceralpha method) was evaluated and improved procedures for measurement of alpha-amylase in durum wheat were devised.

A three-year project on the determination of moisture content in corn using near-infrared transmittance

Grain Biology
Seated (L to R): Steve Symons, Norma Vidal, Louise Cooke, Susan Patrick.
Standing (L to R): Randy Clear, Karen Bell, Connie Butler, Don LaBerge.

(NIT) spectroscopy has been successfully completed. Experiments examined the feasibility of testing high moisture corn using the Trebor GT-30A NIT instrument and the results demonstrated that near-infrared transmittance instruments are capable of determination of moisture in corn, with an accuracy equal to that of capacitance meters up to 28% moisture and superior to these meters at higher moisture levels. While the accuracy of capacitance meters is affected by test weight, particularly at higher moisture levels, NIT instruments function independently of test weight because they employ a different operating principle.

In response to increased use of desiccants in the handling of lentils, a project was launched to develop in-house analytical capability for diquat and paraquat and to initiate screening of commercial shipments of lentils for these compounds. As well, increasing interest in the use of foliar fungicides led to a collaborative study with Rohm and Haas Company into the retention of Mancozeb in barley malt.

Projects in the Grain Biology section continue to focus on utilizing discriminating visual skills and knowledge of the biological elements of grain to study the association between grading and end-use quality.

Experiments with hand-held instruments for seed analysis were undertaken to evaluate their usefulness as possible adjuncts to current visual grading procedures. Two Metron Colormet spectrophotometers, which obtain data and transfer them to a microcomputer for the required calculations, were calibrated and used to accurately analyze ground canola for chlorophyll content. A Minolta colorimeter was used to determine surface color in lentils and field peas. Results to date are promising and indicate that the Minolta instrument offers a quick and convenient means for measuring color.

MARKET SUPPORT ACTIVITIES

Harvest and Cargo Surveys

Surveys of the average quality of different grades of the various classes of Canadian grains and oilseeds harvested each growing season continue to be a major endeavor of the Laboratory. The survey load was successfully completed in time to present reports at meetings of the Eastern and Western Grain Standards Committees of the Canadian Grain Commission, at meetings held between grain industry groups and associations in Eastern Canada and the Canadian Grain Commission and at meetings and discussions held during market support visits to Japan and the United Kingdom. Crop bulletins were also published and distributed internationally for wheat, canola, flaxseed and soybeans. Such publications allow for meaningful dialogue with current and potential customers of Canadian grain on topics relating to the quality parameters normally associated with these grains and oilseeds.

Quality testing of cargo composite samples remains a high priority and the following cargo bulletins documenting the high quality of Canadian grain exports were published and distributed to interested parties throughout the world: *quarterly editions* for red spring wheat, *semi-annual editions* for amber durum wheat and an *annual edition* for canola and flaxseed. Analysis of composite samples in other surveys was also continued: *monthly analysis* of canola cargo composites for oil and protein content, fatty acid composition, free fatty acids, chlorophyll and glucosinolates; *semi-annual analysis* of cargo composites of the Canada Prairie Spring, Canada Western Red Winter, Canada Western Soft White Spring, Canada Western Utility and Canada Eastern White Winter classes of wheat.

Technical Consultations, Missions and Studies

The Director and various Laboratory scientists took part in a number of technical missions and visits to Italy, Mexico, Brazil, Thailand, Singapore, Japan, People's Republic of China, England, Malaysia, Indonesia, Colombia, U.S.A. and Venezuela. Many of these visits required presentation of lectures and seminars on the quality of Canadian grain and, in particular, on the characteristics of the new crop. As well, GRL scientists visited a number of overseas research institutes during the year. For example, Dr. MacGregor travelled to Meudon, France to review collaborative research studies on barley and malted barley proteins with Dr. J. Daussant and his group. He also visited the Scottish Crop Research Institute (Invergowrie, Scotland) to discuss current barley breeding and quality evaluation programs in Scotland.

Overseas market development programs undertaken in 1988 have aided the Canadian Wheat Board in maintaining and/or opening new markets for Canadian wheat. Other market development programs involving the development of higher quality Canada Prairie Spring red and white wheat lines suitable for flat bread and noodle markets are continuing. The amount of testing carried out for the quality assessment of wheats from competing countries increased significantly.

Most of the milling research was directed toward market development, with particular emphasis on techniques used in Latin America. The removal of relatively large amounts of high quality patent flour and/or farina for specialty baked products and pasta is a frequent practice in most Latin American countries when milling common wheat. At the GRL, representative samples of Canadian bread wheat were milled to extractions ranging from 75% to 85%, after which up to 24% (wheat basis) high quality farina was removed. With increased extraction rate, flour color darkened, physical dough properties weakened and baking quality deteriorated. However, at each extraction rate used the removal of up to 24% farina had little effect on residual flour physical dough properties and baking performance, although flour color and flour ash content were significantly affected.

Co-operation between the Grain Research Laboratory and the Canadian International Grains Institute is essential for many of the market support programs. Over the year, numerous tours, lectures,

seminars and practical laboratory demonstrations were organized and presented in order to assist the Grains Institute in its courses for Canadian and foreign participants.

A study to determine the effect on flour quality of milling wheat in a nitrogen atmosphere was completed in collaboration with a visiting scientist from Nippon Flour Milling Company, Japan. Results shed further light on our understanding of the role of oxidation in breadmaking. A laboratory procedure for preparation and quality testing of Chinese steamed bread was developed and the effects on quality of wheat class, sprouting damage and other factors were determined. In a project carried out in the Research Baking section, the effects of surfactants and level of oxidation on the oven-rise properties of Brazilian-type bread were examined.

Other breadmaking research projects included an evaluation of the baking performance of Canadian bread wheat classes when a Canadian short process and a Colombian high sugar, high fat short process are used. Differences were evident in the relative performances in both processes - with CWRS wheat flour yielding the best overall Colombian bread quality. Experiments in which sugar, shortening and egg content levels were varied in the production of aliñado bread, the most popular bread in Colombia, revealed that specific volume was reduced by high levels of sugar and/or shortening. High shortening content also imparted a firmer, less resilient crumb texture, while eggs had little effect on bread properties.

Laboratory Milling and Research
Seated (L to R): John Burrows, Jim Dexter, Dave Martin, Nancy Edwards.
Standing (L to R): Julien Lachance, Jim Spicer, Gerry Holowka, Bob Ouellette, Rolly Desjardins.

Breadwheat Quality and Breadmaking Research.
Seated (L to R): Garth Paulley, Ken Preston, Henry Kilborn, Les Pelletier, Ivan Phillips.
Standing (L to R): Lloyd Minty, Barry Morgan, Ed Mydlo, Craig Taplin, Greg Kawamoto, Ed Lysenko.

RESEARCH ACTIVITIES

Wheat

It is well-known that structure and quantity of wheat proteins, especially the storage proteins, are directly related to many breadmaking quality characteristics. Although we now have the technology to rapidly analyze for protein quantity, the same cannot be said for protein quality. A prerequisite to the development of such techniques, however, is that we must gain a firm understanding of how proteins are related to end product quality.

Recent published studies have demonstrated the unequivocal relationship between specific wheat proteins and breadmaking quality. In particular, various combinations of individual high molecular weight glutenin subunits have been correlated with either good or poor breadmaking quality. Because of the importance of these proteins, procedures have been developed for their analysis-including those using sodium dodecyl sulphate polyacrylamide gradient-gel electrophoresis (SDS gradient PAGE) and reversed-phase high performance liquid chromatography (RP-HPLC).

Utilizing RP-HPLC and SDS gradient PAGE, the storage proteins of a number of wheat backcross lines were analyzed. This study provided further information on the relationship between the high molecular weight glutenin subunits and quality characteristics such as loaf volume. Lower molecular weight glutenin proteins also appear to affect quality. This work indicated that RP-HPLC may be a valuable tool for prediction of wheat quality.

A project was completed on the effects of neutral salts on the physical dough properties of wheat flour. Results could have a major theoretical impact on our understanding of gluten protein properties such as hydrophobicity and sensitivity to conformational changes. In another experiment, the relationship between quality characteristics and gluten protein properties was studied using samples of wheat obtained from throughout the world.

Sprouting damage adversely affects the quality of wheat. The major decrease in quality can be attributed to the presence of high levels of the enzyme alpha-amylase, but high levels of proteolytic enzymes, which also are found in sprouted grain, may adversely affect quality by damaging the quality-related storage proteins. In particular, damage to high molecular weight (HMW) glutenin subunits which confer "good" quality presumably can have a significant deleterious effect. Therefore, a study was carried out to monitor the effect of sprouting on the HMW glutenin subunits by RP-HPLC and SDS gradient PAGE. The results

Wheat Chemistry and Laboratory Services
Seated (L to R): Lori Macri, Josi Kopilas, Sandy Gowan, Shirley Lowe, Jean Mellish.
Standing (L to R): Harold Hughes, Russ Tkachuk, Gerry Bell, Máté Hidvégi , Bob Wallis, Gil Baker.

showed that these proteins were degraded in a complex manner during sprouting, probably by a combination of enzymes.

The performance of the PhastSystem, which utilizes miniature, pre-made SDS gradient gels and microprocessor-controlled electrophoresis and staining, was evaluated for rapid identification of wheat cultivars. The system is compact, provides for rapid analysis, has cultivar-identification capability comparable to that of conventional procedures and is very easy to operate. However, it is less economical in processing large numbers of single kernel samples in an operational setting, and therefore may be more suitable in a situation where smaller numbers of samples need to be identified on an intermittent basis. Evaluation of an ISO Dalt Electronics apparatus was also completed and results indicated that improved separation of gliadin proteins was not achieved - compared with the currently-used PAGE system.

A study to determine whether the storage protein composition of wheat is influenced by environment was expanded to include different cultivars as well as samples from additional environments. Statistical analyses demonstrated that environment does have a significant interaction with storage protein composition - which may hamper cultivar identification and may also have implications in quality determinations.

Studies to estimate, colorimetrically using iodine, the residue in the water after cooking spaghetti, have been completed and indications are that results with this much more efficient technique are highly correlated with those from the freeze-drying method

Cereal Protein Research
Seated (L to R): Kathy Handel, Pat Funk.
Standing (L to R): Brian Marchylo, Michael Edney.

Wheat Enzyme Research
Seated (L to R): Donna Daniel, Sharon Moffat, Helena Facto.
Standing (L to R): Lawrence Morris, Dave Hatcher, Jim Kruger.

presently employed. A project to examine the factors, specifically minerals, affecting surface stickiness and textural characteristics of cooked spaghetti is continuing.

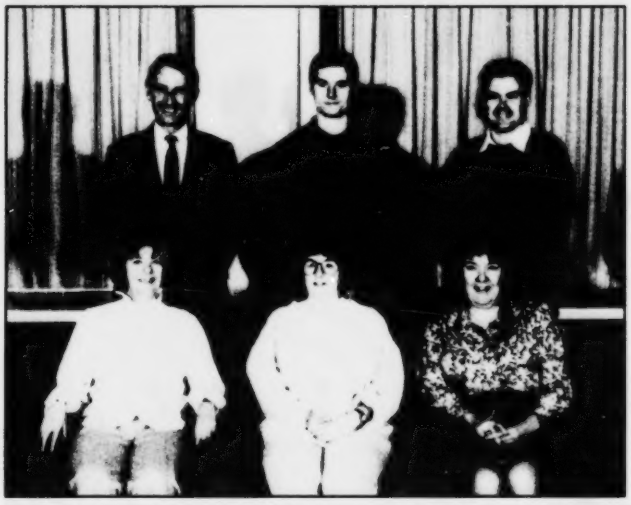
Near-infrared reflectance studies were performed using wheat samples having temperatures ranging from -5°C to 49°C. Spectral absorption differences were obtained in the reflectance data and, depending on the wavelength used, these differences could lead to inaccurate predictions of protein content.

Moisture content has been shown to exert an influence on wheat hardness measurements to varying degrees - dependent on the technique used. The most pronounced effects were observed when using the grinding-time and rpm reduction tests, with the cyclone-ground particle size index and near-infrared reflectance methods the least affected. Between 10.0 and 12.5% moisture content, effects were negligible for both the latter two tests and significant for the grinding-time test, particularly when analyzing soft wheat.

Barley

Barley kernels contain a component, beta-glucan, that is responsible for the high viscosity levels of extracts of some barley cultivars. These high viscosity levels reduce considerably the feeding value of barley for chickens and may cause problems during malting and brewing. Studies utilizing specific enzymes showed that, at high beta-glucan levels (*ca.* 5%), a small increase in beta-glucan content could result in a large increase in viscosity of the barley extract. This appears to explain why extracts of some barley cultivars may vary widely in viscosity although the original barleys contain similar amounts of beta-glucan. The presence of a minor beta-glucan component in barley has been studied using microscopy techniques. Although this material may affect the end-use quality of barley, it does not appear to affect significantly the viscosity of barley extracts.

An enzyme that catalyzes the dissolution of barley beta-glucan has been isolated from barley kernels. Examination of extracts from different barley tissues indicated that the enzyme, called beta-glucan solubilase, was associated with the husks only. Further studies showed that the enzyme was generated by microflora on the barley grain and that there was a relationship between enzyme level and extent of weathering of the grain.



Basic Barley Research
Seated (L to R): Ann MacGregor, Robyn Roscoe, Joan Morgan. Standing (L to R): Sandy MacGregor, Steve Schroeder, Len Dushnicky.

Use of a new beaded hydrophilic resin (Mono P) reduces the time required to establish a pH gradient and elute a column from 12 hours to 2 hours. A chromatofocusing study, with confirmation by isoelectric focusing, indicates that there is no loss of resolution (*i.e.*, change in apparent pI) of beta-amylases eluted from Mono P columns. Previous experiments using disc-electrophoresis demonstrated that peroxidase patterns of barley cultivars were complex and might be useful markers for non-visual identification purposes. These observations are being investigated further using chromatofocusing on Mono P columns.

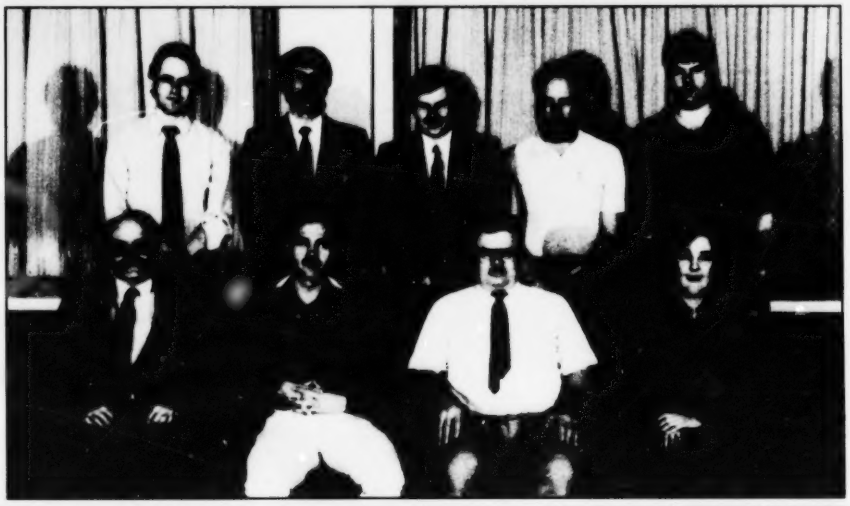
Oilseeds

The major activities this year centered on projects involving chlorophyll in canola. An initial round-robin collaborative test, in co-operation with the International Standards Organization (ISO), for a reference procedure for the determination of chlorophyll content in canola was begun.

Factors affecting the determination of chlorophyll by reflectance spectroscopy were studied. A report presented to the American Oil Chemists' Society (AOCS) on the HPLC and spectrophotometric determination of chlorophyll pigments in canola oil has caused the AOCS to re-evaluate its method for determination of chlorophyll in oils. A study on the determination of glucosinolates by the thymol procedure was completed and an initial round-robin study of this method was commissioned by the AOCS for use in the development of official methods for glucosinolate analysis.

Work on the content of vaccenic acid in residual oils from oilseed meals led to the discovery that this unusual fatty acid forms a significant proportion of the structural triglycerides of *Brassica* oilseeds. Wax esters, probably originating from the seed coat, were found to be a major constituent of haze formed in canola oils. Research into the determination of oil content in oilseeds by extraction procedures suggests that effective grinding to reduce particle size to less than 100 micrometers appears to be essential for efficient oil extraction.

As a result of increasing commercial interest into the sulphur content levels of oil destined for hydrogenation, preliminary work has been carried out at the GRL into the "Raney nickel" method of sulphur analysis. It is anticipated that research on this topic will continue.



Oilseeds Research
Seated (L to R): Tom Thorsteinson, Barry Misener, Paul Mazur, Kathleen Clear.
Standing (L to R): Karl Dashensky, Doug DeClercq, Jim Daun, Ken Howard, Garth Steidl.

Analytical Methodology

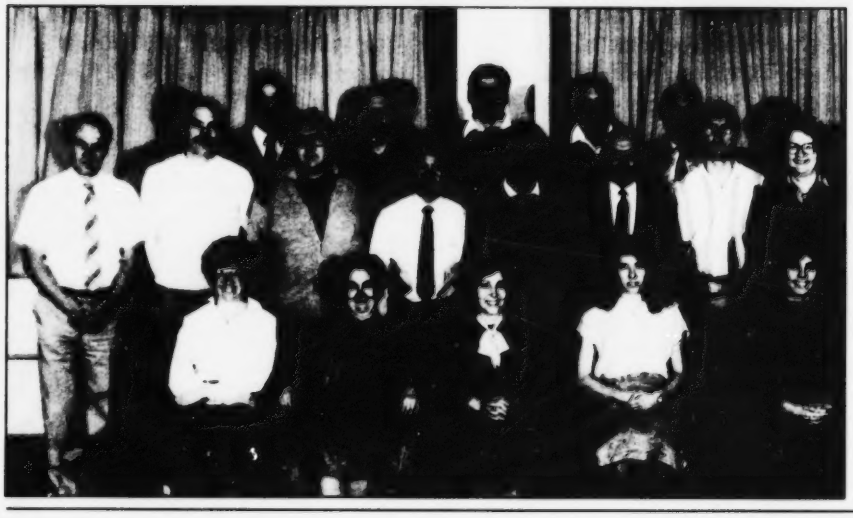
Application of gas chromatography with mass selective detection in conjunction with sample preparation employing an automated gel permeation chromatography-concentrative evaporation apparatus has shown considerable promise for determination of grain desiccants such as diquat in lentils.

The Karl Fischer titration method for determining moisture content was applied to samples of corn and wheat, and preliminary indications are that test results agree closely with those obtained using the oven-moisture techniques currently in use as reference procedures at the Grain Research Laboratory.

The Tecator Infratec Model 1225 near-infrared transmittance spectroscopy instrument was evaluated for the analysis of wheat for protein, moisture and falling number; of barley for protein and moisture; of soybean for protein, oil and moisture; and of corn for moisture. Two such instruments were also calibrated to predict kernel hardness in wheat, and the calibration developed for one was transferable to the other with good agreement in performance after a slope/bias correction.

Installation of a Kontron Image Analysis system was completed with respect to hardware components - including photofluorescence microscope, monochrome and color video cameras and associated computer. Although acquisition of software is not yet complete, computer-assisted image enhancement and analysis routines are being developed for application to the rapid quantification of shape, size, color and texture of grains, grain structure and commercial grain products.

An effective monitoring procedure, involving assessment of the mixing properties of micro-milled semolina, has been devised for the detection of heat damage in durum wheat.



Analytical Development and Services
Front Row (L to R): Theresa Harnden, Carole Panting, Helena Cordeiro, Debbie Heide, Shaylene Harborne.
Middle Row (L to R): Phil Williams, Willy Aarts, Tim Boomer, Young Lim, Janet Panford, Len Oneschuk, Dan Saydak, Susan Stevenson.
Back Row (L to R): George Hennessey, Bob Brady, Dennis Parent, Chris Ashley, James Yau.

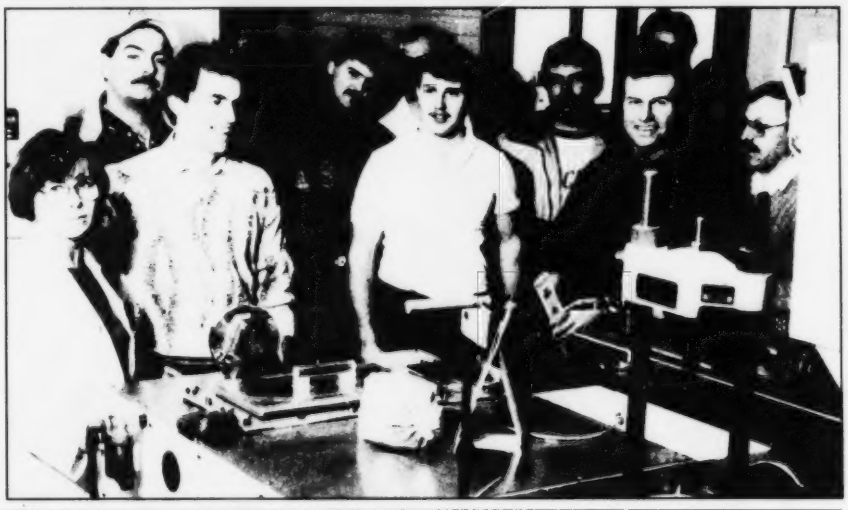
LIAISON ACTIVITIES

Visitors to the Grain Research Laboratory

Again this year, the Grain Research Laboratory (GRL) had over 1,000 persons tour its facilities, with tours ranging from short walk-throughs to half-day sessions involving detailed technical demonstrations and discussions with GRL experts. Of the total of 1,002 visitors (representing 85 separate groups), 93 were from the following 24 countries: Argentina, Australia, Belgium, Brazil, Chile, Colombia, Denmark, Egypt, England, Federal Republic of Germany, France, Hungary, India, Italy, Japan, Korea, Mali, New Zealand, People's Republic of China, Philippines, Sweden, Switzerland, U.S.A., and Wales. Not included in the preceding list are the numerous countries represented by participants in Canadian International Grains Institute courses which incorporate tours of the GRL.

Among the visitors were Mr. D. Mazankowski, Deputy Prime Minister and Minister of Agriculture, and Mr. C. Mayer, Minister of State for Grains and Oilseeds and Minister Responsible for the Canadian Wheat Board. The following are some of the varied interest groups from across Canada (and their numbers) accommodated: 386 grain producers, 48 elevator managers, 26 grain company representatives, 161 students in degree or diploma courses in agriculture at universities or community colleges, and 9 individuals involved with the transportation of grain by rail or ship.

Two holders of travelling fellowships from the Natural Sciences and Engineering Research Council of Canada (NSERCC) undertook research projects at the GRL this year: M. Edney in the Cereal Protein Research section and M. Hidvégi in the Basic Wheat Research section. Miss L.J. Malcolmson continued her research studies in the Durum Wheat section - toward fulfilling the requirements for the PhD degree at the University of Manitoba. Her project topics are: relationship between sensory, physical and microstructural assessments of cooked spaghetti; and textural optimization of spaghetti using response surface methodology. Dr. X. Yin, previous holder of a NSERCC fellowship, completed his project on beta-glucan solubilase in barley and returned to his home in the People's Republic of China. Dr. E.A. MacGregor, on sabbatical from the University of Manitoba, has begun studies in the Basic Barley Research section on the structures of starch-degrading enzymes.



Technologist Nancy Edwards visiting the durum wheat research section with a group of Manitoba grain producers during their tour of the GRL. Laboratory-scale spaghetti processing equipment is in the foreground.

Committee Membership

Canadian Grain Commission
- Eastern and Western Grain Standards Committees ..... K.H. Tipples

Agriculture Canada
- Advisory Committee on Variety Registration ..... R.R. Matsuo
- Expert Committee on Fats, Oils and Other Lipids ..... J.K. Daun
- Inter-Branch Working Group on Fumigants ..... T.W. Nowicki
- Western Expert Committee on Grain Quality ..... K.H. Tipples *(chair)*
  R.R. Matsuo *(secretary)*
  D.E. LaBerge
  K.R. Preston
  R. Tkachuk
  - Subcommittee on Barley and Oats ..... D.E. LaBerge *(chair)*
    A.W. MacGregor
    - Ad Hoc Subcommittee on Oats ..... A.W. MacGregor
  - Subcommittee on Oilseeds and Special Crops ..... J.K. Daun *(chair)*
    D.R. DeClercq
    R. Tkachuk
  - Subcommittee on Wheat ..... K.R. Preston *(chair)*
    R.R. Matsuo
    P.C. Williams

Agricultural Institute of Canada
- Associate Editor, Canadian Journal of Plant Science ..... K.R. Preston

American Association of Cereal Chemists
- Technical Committees:
  - Amylase Methods ..... J.E. Kruger *(co-chair)*
    A.W. MacGregor *(co-chair)*
  - Bread Baking Methods ..... R.H. Kilborn
    K.R. Preston
  - Experimental Milling ..... J.E. Dexter *(chair)*
  - Methods for Grain Testing ..... P.C. Williams
  - Near-infrared Reflectance ..... P.C. Williams
  - Pasta Products Analysis ..... J.E. Dexter
    R.R. Matsuo
  - Physical Testing Methods ..... R.H. Kilborn
    K.R. Preston
  - Quality Tests for Wheat and Flour ..... R. Tkachuk
  - Total Dietary Fiber ..... P.C. Williams
- Canadian Prairie Section ..... V.J. Mellish *(vice-chair)*
  D.W. Hatcher *(secretary-treasurer)*
- Publications Committee ..... J.E. Kruger
- Board of Editors, Cereal Chemistry ..... J.E. Dexter
  B.A. Marchylo
- Osborne Medal Award Committee ..... R. Tkachuk

American Oil Chemists' Society
- Annual Meeting (1992) Program Committee ..... J.K. Daun *(chair)*
- Awards Committee ..... J.K. Daun
- Canadian Section ..... J.K. Daun *(vice-president)*
- Commercial Fats and Oils Analysis Committee ..... J.K. Daun
- Seed and Meal Analysis Committee
  - Rapeseed and Canola Working Group ..... J.K. Daun *(co-ordinator)*

Brewing and Malting Barley Research Institute
- Technical Committee ..... D.E. LaBerge

Canadian General Standards Boards
- Committee on Bakery and Cereal Products ..... R.R. Matsuo

Canadian Institute of Food Science and Technology
- 1988 Conference Committee ..... R.R. Matsuo *(chair)*
  J.E. Dexter

Codex Alimentarius Commission, FAO/WHO
- Canadian Delegation ..... R. Tkachuk *(chair)*

Federal Interdepartmental Committee on Pesticides Check Sample Program
- Feeds/Grains Sub-program ..... T.W. Nowicki *(co-ordinator)*

Flax Council of Canada
- Market Development Committee ..... J.K. Daun

International Association for Cereal Science and Technology (ICC)
- Executive Committee, Technical Committee and General Assembly ..... K.H. Tipples
- Working Groups on:
  - Variety Identification by Electrophoresis ..... R. Tkachuk
  - Baking Tests ..... K.H. Tipples *(chair)*
  - Determination of Wet Gluten ..... K.R. Preston
  - Particle Size ..... P.C. Williams
  - Methods of Protein Determination ..... R. Tkachuk
  - Sampling ..... P.C. Williams
  - Near-infrared Technology ..... P.C. Williams

International Committee on Pre-Harvest Sprouting ..... J.E. Kruger

International Gluten Workshop (1990)
- Organizing Committee ..... R. Tkachuk *(chair)*

International Rapeseed Congress (1992)
- Program Committee ..... J.K. Daun

International Standards Organization
- Canadian Advisory Committee TC34/SC4 ..... K.H. Tipples *(chair)*
- Canadian Advisory Committee TC34/SC2 ..... J.K. Daun

Journal of Cereal Science
- Board of Editors ..... K.H. Tipples

Manitoba Sunflower Committee ..... J.K. Daun

Master Brewers' Association of the Americas
- Housing Committee for 1992 Convention ..... D.E. LaBerge *(chair)*

Red River Community College
- Advisory Committee for Chemical and Biochemical Technology ..... R. Tkachuk
  D.E. LaBerge

University of Manitoba
- Adjunct Professors, Department of Plant Science ..... J.E. Kruger
  A.W. MacGregor
  R.R. Matsuo
  R. Tkachuk
  P.C. Williams

Winnipeg Brewmasters Association
- Technical Chair ..... D.E. LaBerge

Conference and Meeting Attendance

Agriculture Canada
- Advisory Committee on Variety Registration
  - Meeting in Ottawa, ON ..... K.H. Tipples
- Expert Committee on Fats, Oils and Other Lipids
  - 1988 Meeting, Ottawa, ON ..... J.K. Daun
- Western Expert Committee on Grain Quality
  - 1989 Meeting, Ottawa, ON ..... R.M. Clear
    J.K. Daun
    D.E. LaBerge
    A.W. MacGregor
    R.R. Matsuo
    K.R. Preston
    R. Tkachuk
    K.H. Tipples
    P.C. Williams
- Eastern Expert Committee on Grain Quality
  - 1989 Meeting, Ottawa, ON ..... K. H. Tipples

Research Branch Wheat Breeding Program	
Workshop in Winnipeg, MB	R.R. Matsuo
	K.R. Preston
Western Computer Users Meeting	
Banff, AB	R. Tkachuk
American Association of Cereal Chemists	
Annual Meeting, San Diego, CA	J.E. Dexter
	J.E. Kruger
	A.W. MacGregor
	B.A. Marchylo
	K.R. Preston
	S.J. Symons
	K.H. Tipples
	R. Tkachuk
	P.C. Williams
Japan Local Section Meeting	
Tokyo, Japan	K.H. Tipples
Milling and Baking Technical Conference	
San Antonio, TX	F.G. Paulley
Starch Round Table	
San Diego, CA	A.W. MacGregor
Wheat Industry Utilization Seminar	
San Diego, CA	R. Tkachuk
American Chemical Society	
Annual Meeting, Toronto, ON	N.H. Barchuk
American Oil Chemists' Society	
Annual Conference, Phoenix, AZ	J.K. Daun
	J.A. Panford
Canadian Section Conference, Ottawa, ON	J.K. Daun
Commercial Fats and Oils Committee	
Meeting in Chicago, IL	J.K. Daun
American Society of Brewing Chemists	
Annual Meeting, Minneapolis, MN	D.E. LaBerge
Association of Official Seed Analysts	
Annual Meeting, Rochester, NY	L.A. Cooke
Association of Operative Millers	
Annual Conference, Denver, CO	R.G. Desjardins
Joint Conference with AACC, Montreal, PQ	B.C. Morgan
Joint Conference with AACC, Winnipeg, MB	Nineteen staff members attended

Barley Improvement Conference
Minneapolis, MN ..... D.E. LaBerge

Brazil-Canada Wheat Symposium
Rio de Janiero, Brazil ..... K.H. Tipples

Brewing and Malting Barley Research Institute
Technical Committee Meeting, Winnipeg, MB ..... D.E. LaBerge

Canada Grains Council
Annual Meeting, Vancouver, B.C. ..... K.H. Tipples

Canada-Japan Consultations on Canola
Tokyo, Japan ..... J.K. Daun

Canadian Institute of Food Science and Technology
Annual Meeting, Winnipeg, MB ..... J.K. Daun
J.E. Dexter
R.R. Matsuo

Canola Industry Conference
Saskatoon, SK ..... D.R. DeClercq

Codex Alimentarius Commission, FAO/WHO Session
Washington, DC ..... R. Tkachuk

Crop Quality Council
Annual Meeting, Kansas City, MO ..... K.R. Preston

Durum Wheat Bread Seminar
Troina, Sicily ..... R.R. Matsuo

Eighth International Cereal and Bread Congress
Lausanne, Switzerland ..... J.E. Kruger
K.H. Tipples
R. Tkachuk

Hecla '88 - Operation 2000
Hecla, MB ..... N.H. Barchuk
D.E. LaBerge
R.R. Matsuo
K.H. Tipples
R. Tkachuk

International Association for Cereal Science and Technology (ICC)
General Assembly and Meeting of Executive and Technical Committees,
Lausanne, Switzerland ..... K.H. Tipples

International Conference on Diffuse Reflectance Spectroscopy
Chambersburg, PA ..... R. Tkachuk
P.C. Williams

International Electrophoresis Society
Meeting in Copenhagen, Denmark ..... B.A. Marchylo

International Near-Infrared Symposium
Moscow, U.S.S.R. ..... P.C. Williams

International Standards Organization
TC34/SC4 Committee Meeting, Detmold, FRG ..... R. Tkachuk

International Symposium on Cereal Carbohydrates
Edinburgh, Scotland ..... A.W. MacGregor

International Union on Pure and Applied Chemistry
Symposium on Mycotoxins and Phycotoxins
Tokyo, Japan ..... T.W. Nowicki

Italian-Canadian Wheat Symposium
Stresa, Italy ..... K.H. Tipples

Manitoba Agri-Forum
Winnipeg, MB ..... R.M. Clear
L.A. Cooke

Manitoba Agricultural Services Co-ordinating Committee
Meeting of Subcommittee on Oilseeds and Special Crops,
Winnipeg, MB ..... D.R. DeClercq

Manitoba Institute of Agrologists
Annual Meeting, Brandon, MB ..... L.A. Cooke

Manitoba Sunflower Committee
Annual Tour ..... J.K. Daun

Master Brewers' Association of the Americas
District Western Canada Annual Convention
Winnipeg, MB ..... L.A. Cooke
D.E. LaBerge *(housing chair)*
A.W. MacGregor
B.A. Marchylo
X. Yin
District Eastern Canada Meeting, St. John's, NF ..... D.E. LaBerge

Oilseeds 1989 Symposium
Sydney, Australia ..... J.K. Daun

Pesticide and Trace Organic Residue Analysts (Western Canada)
Annual Workshop, Regina, SK ..... T.W. Nowicki

Pittsburgh Conference on Analytical Chemistry
Atlanta, GA ..... L.J. Macri

Safety and Health Conference
Toronto, ON ..... N.H. Barchuk

Spring Wheat Quality Advisory Council
Annual Meeting, Minneapolis, MN ..... K.R. Preston

Statistical Society of Canada
Annual Meeting, Victoria, B.C. ..... J.C. Babb

Zeiss Science Fair
Toronto, ON ..... S.J. Symons

Oral Presentations

At Canadian International Grains Institute

K.H. Tipples
- Introduction to the Grain Research Laboratory
- Plant Breeding and the Marketplace

J.C. Babb
- Sampling and Statistical Analysis

R.M. Clear
- Field Mycology
- Moulds Found on Canadian Grains and Their Effects on Grading

J.K. Daun
- Oilseed Grading Factors and Related End-Use Product Quality

D.R. DeClercq
- Effects of Grading Factors on End-Use Quality of Canadian Grains

D.R. DeClercq and K.M. Clear
- Oilseed Quality Analysis Techniques

J.E. Dexter

The Grain Research Laboratory
Scientific Support for Canada's Grain Grading System
Effects of Grading Factors on Wheat and Malting Barley End-Use Quality
Elementary Statistics and Data Interpretation
Millstream Analysis
Experimental Error and Experimental Design
Relation of Wheat Class and Grade to End-Use Quality
Effects of Grading Factors in Wheat

J.E. Dexter and J.J. Lachance

Experimental Milling at the GRL *(presented twice)*

J.E. Dexter and D.G. Martin

Experimental Milling at the GRL *(presented three times)*

J.E. Kruger and L.J. Morris

Falling Number and Related Quality Tests

D.E. LaBerge

Introduction to the GRL *(presented twice)*

A.W. MacGregor

Introduction to the GRL
Structure and Composition of Barley Kernels

A.W. MacGregor and L.G. Dushnicky

Application of Microscopy to Grain Quality Evaluation *(presented three times)*

B.A. Marchylo

Identification of Cereal Cultivars by Non-Visual Chemical Methods
Introduction to the Grain Research Laboratory
Barley Proteins
Varietal Identification of Wheat and Barley Proteins *(presented three times)*

R.R. Matsuo

Plant Breeding and the Marketplace
Measurement of Pasta Quality
Pasta Manufacturing

V.J. Mellish

Electrophoresis

T.W. Nowicki

Toxic Chemical Contaminants in Grain *(presented twice)*
Quality Control and Quality Assurance of Canadian Grain for Toxic Chemical Contaminants

S.J. Symons
Microcomputers and Image Analysis

R. Tkachuk
Outline and Introduction to Grain Instrumentation Technology Course
Introduction to Proteins

R. Tkachuk and L.J. Macri
Chlorophyll

R. Tkachuk and R.J. Wallis
Birth of a Moisture Chart

P.C. Williams
New Developments in NIR Technology
Wheat: Properties, Functionality and End-Uses *(presented twice)*

P.C. Williams and J.A. Panford
Measurement of Protein and Moisture Using NIRS

At Conferences, Meetings and Seminars

K.H. Tipples
The Grain Research Laboratory
Quality of the 1988 Canadian Wheat Crop
Brazil-Canada Wheat Symposium, Rio de Janiero, Brazil
The Grain Research Laboratory
Relationship of Wheat Class and Grade to End-Use Quality
Italian-Canadian Wheat Symposium, Stresa, Italy
Canadian Wheat: Class, Variety and Grade from a Quality Perspective
Canada Grains Council, Annual Meeting, Vancouver, B.C.
Wheat Quality and the Baking Process
Eighth International Cereal and Bread Congress, Lausanne, Switzerland
Recent Research at the Grain Research Laboratory
AACC, Japan Local Section Meeting, Tokyo, Japan
Market Development Baking Studies at the GRL
AOM-AACC, Local District Joint Conference, Winnipeg, MB

J.C. Babb
Statistical Consulting at the Grain Research Laboratory
Statistical Association of Manitoba, Seminar, Winnipeg, MB

R.M. Clear
Fusarium Species and Mycotoxins Associated with Scabby Wheat Seed Samples
Expert Committee Meetings, Ottawa, ON

L.A. Cooke

Barley Nobody Malts
MBAA, District Western Canada Annual Convention, Winnipeg, MB

J.K. Daun

Determination of Chlorophyll Pigments in Crude and Degummed Canola Oils by HPLC and Spectrophotometry
Causes of Turbidity in Canola Oil *(Poster)*
Determination of Oil Content in Canola Seed by a Modified Regrind Procedure: Comparison with Grinding with Diatomaceous Earth
American Oil Chemists' Society, Annual Meeting, Phoenix, AZ
Stability of Linolenic Acid During Preparation, Baking and Storage of Bread Prepared from Flour Fortified with Ground Flaxseed *(Poster)*
CIFST, Annual Meeting, Winnipeg, MB
Studies on the Determination of Chlorophyll in Canola by HPLC, Modified NIR Reflectance and Extraction and Spectrophotometry
AOCS, Canadian Section Meeting, Ottawa, ON
Preliminary Report on the Quality of the 1988 Canola Crop
Canada-Japan Canola Consultations, Tokyo, Japan

D.R. DeClercq

Final Report on the Quality of the 1988 Canola Crop
Canola Industry Meeting, Saskatoon, SK

J.E. Dexter

Durum Wheat Production, Marketing and Utilization
Durum Wheat Quality Requirements
Noodle Technology
Wheat Processing in Colombia
Kansas State University, Dept. Grain Sci. Industry, Manhattan, KS
Effect on Residual Flour Quality of Removing High Quality Farina During Common Wheat Milling
AACC, Annual Meeting, San Diego, CA

J.E. Kruger

Evaluation of Newer Methods for Measuring Sprout Damage in Cereals
Eighth Internationl Cereal and Bread Congress, Lausanne, Switzerland

A.W. MacGregor

Malting: Art or Science?
University of Manitoba, Department of Chemistry, Winnipeg, MB
Possible Usefulness of High and Low Amylose Barley for Malting and Brewing
MBAA, District Western Canada Meeting, Winnipeg, MB
Hydrolysis of Maltodextrins and Modified Maltodextrins by Alpha-Amylases from Malted Barley
International Symposium on Cereal Carbohydrates, Edinburgh, Scotland
Hydrolysis of Maltodextrins by Cereal Alpha-Amylases
AOM-AACC, Local Section Joint Conference, Winnipeg, MB

A.W. MacGregor *(cont.)*

Action of Amylases of Malted Barley
Starch Round Table, San Diego, CA

Identification of RNA for Alpha-Amylase Components in Barley Tissues Using Specific cDNA Probes
AACC, Annual Meeting, San Diego, CA

The Structure of Cereal Grains

The Chemistry and Biochemistry of Malting
MBAA, Short Course on Brewing and Malting Science, Madison, WI

Six Lectures on "The Production and Technology of Canadian Barley"
University of Manitoba, Department of Plant Science, Winnipeg, MB

B.A. Marchylo

Application of RP-HPLC to the Qualitative and Quantitative Analysis of Wheat and Barley Storage Proteins
AACC, Annual Meeting, San Diego, CA

Separation of Wheat and Barley Proteins by Rapid Horizontal Electrophoresis *(Poster)*
International Electrophoresis Society Meeting, Copenhagen, Denmark

The Development of Chemical Methods to Identify Wheat and Barley Varieties
University of Manitoba, Department of Chemistry, Winnipeg, MB

R.R. Matsuo

Use of Durum Wheat for Bread
Seminar in Troina, Sicily

Canadian Wheat: Quality Control System
Flour Millers Seminar, Bangkok, Thailand
Taiwan Flour Mills Association, Seminar, Taipei, Taiwan

B.C. Morgan

Quality of the 1988 Canadian Wheat Crop
Association of Operative Millers, District #8 Meeting, Montreal, PQ

T.W. Nowicki

Multiresidue Pesticide Analysis of Grains Using GPC Cleanup, Automatic Solvent Evaporation and GC-MSD Screening
Pesticide and Trace Organic Residue Analysts (Western Canada), Annual Workshop, Regina, SK

K.R. Preston

Description and Application of a Bread Height Tracker for a Heat Sink Oven
AACC, Annual Meeting, San Diego, CA

An Assessment of Long-Term Quality Objectives for Wheat Breeding in Western Canada
Agriculture Canada Research Branch, Wheat Breeding Program Workshop, Winnipeg, MB

Quality Characteristics of CWRS, CWRW and CWSWS Wheat
Flour Millers Seminar, Bangkok, Thailand
Taiwan Flour Mills Association, Seminar, Taipei, Taiwan

R. Tkachuk

Identification of Canadian Wheat Varieties Using Electrophoretic Procedures
Eighth International Cereal and Bread Congress, Lausanne, Switzerland

P.C. Williams

Factors Involved in Large-Scale Testing of Wheat for Protein by
Near-Infrared Reflectance Spectroscopy
International Near-Infrared Symposium, Moscow, USSR

PUBLICATIONS

Scientific Papers

570 DEXTER, J.E., WILLIAMS, P.C., EDWARDS, N.M., MARTIN, D.G.
The Relationships Between Durum Wheat Vitreousness, Kernel Hardness and Processing Quality.
J. Cereal Sci. 7:169-181, 1988.

600 TKACHUK, R., MELLISH, V.J.
Use of Two-Dimensional Electrophoresis Procedures to Characterize Wheat Proteins.
Proc. Third International Workshop on Gluten Proteins: 111-124, 1987.

602 WILLIAMS, P.C., FOUAD JABY EL-HARAMEIN, NELSON, W., SRIVASTAVA, J.P.
Evaluation of Wheat Quality for the Baking of Syrian-Type Two-Layered Flat Breads.
J. Cereal Sci. 7:195-207, 1988.

603 WILLIAMS, P.C., FOUAD JABY EL-HARAMEIN, ORTIZ-FEREIRA, G., SRIVASTAVA, J.P.
Preliminary Observations on the Determination of Wheat Strength by Near-Infrared Reflectance.
Cereal Chem. 65(2):109-114, 1988.

604 DEXTER, J.E., MARTIN, D.G., MATSUO, R.R.
The Effect of Roll Flute Orientation on Durum Wheat Experimental Milling Performance and Semolina Quality.
Can. Inst. Food Sci. Tech. J. 21(2):187-193, 1988.

606 MARCHYLO, B.A., KRUGER, J.E.
The Effect of Injection Volume on the Quantitative Analysis
of Wheat Storage Proteins by Reversed-Phase High-Performance Liquid Chromatography.
Cereal Chem. 65(3):192-198, 1988.

607 KRUGER, J.E., MARCHYLO, B.A., HATCHER, D.W.
Preliminary Assessment of a Sequential Extraction Scheme for Evaluating Quality by Reversed-Phase High Performance Liquid Chromatography and Electrophoretic Analysis of Gliadins and Glutenins.
Cereal Chem. 65(3):208-214, 1988.

608 PANFORD, J.A., WILLIAMS, P.C., DEMAN, J.M.
Analysis of Oilseeds for Protein, Oil, Fiber and Moisture by Near-Infrared Reflectance Spectroscopy.
J. AOCS 65(10):1627-1634, 1988.

609 VAN CAESEELE, L., MACGREGOR, A.W.
Alpha-Amylase in Seed Hulls of Developing *Brassica Campestris*.
Can. J. Bot. 66:1461-1464, 1988.

610 YIN, X.S., MACGREGOR, A.W.
An Approach to the Identification of a Beta-Glucan Solubilase from Barley.
J. Inst. Brew. 94:327-330, 1988.

611 MACGREGOR, A.W., MARCHYLO, B.A., KRUGER, J.E.
Multiple Alpha-Amylase Components in Germinated Cereal Grains
Determined by Isoelectric Focusing and Chromatofocusing.
Cereal Chem. 65(4):326-333, 1988.

612 MACGREGOR, A.W., DUSHNICKY, L.G.
Alpha-Amylase in Developing Barley Kernels - A Reappraisal.
J. Inst. Brew. 95:25-33, 1989.

614 NOWICKI, T.W., GABA, D.G., DEXTER, J.E., MATSUO, R.R., CLEAR, R.M.
Retention of the *Fusarium* Mycotoxin Deoxynivalenol in Wheat
During Processing and Cooking of Spaghetti and Noodles.
J. Cereal Sci. 8:189-202, 1988.

615 BHATTY, R.S., MACGREGOR, A.W.
Gamma Irradiation of Hulless Barley: Effect on Grain Composition, Beta-Glucans and Starch.
Cereal Chem. 65(6):463-470, 1988.

616 SYMONS, STEPHEN J., FULCHER, R.G.
Determination of Wheat Kernel Morphological Variation by Digital Image Analysis:
I. Variation in Eastern Canadian Milling Quality Wheats.
J. Cereal Sci. 8:211-218, 1988.

617 SYMONS, STEPHEN J., FULCHER, R.G.
Determination of Wheat Kernel Morphological Variation by Digital Image Analysis:
II. Variation in Cultivars of Soft White Winter Wheats.
J. Cereal Sci. 8:219-229, 1988.

618 SCANLON, M.G., DEXTER, J.E., BILIADERIS, C.G.
Particle-Size Related Physical Properties of Flour Produced by Smooth Roll Reduction
of Hard Red Spring Wheat Farina.
Cereal Chem. 65(6):486-492, 1988.

619 PRESTON, K.R., MORGAN, B.C., TIPPLES, K.H.
A Review and Analysis of Export Cargo Quality Data
for Canada Western Red Spring Wheat: 1973-1986.
Can. Inst. Food Sci. Tech. J. 21(5):520-530, 1988.

622 BABB, J.C., DEMPSTER, C.J., WALLIS, R.J.
Prediction of the Moisture Content of Eastern Canadian Corn
Using Measurements of Capacitance and Test Weight.
Can. J. Plant Sci. 69:109-119, 1989.

623 KRUGER, J.E., BABB, J.C., MORRIS, L.J., TIPPLES, K.H.
Ability of the Canadian Grading System to Segregate Canadian Wheat by Alpha-Amylase Levels.
Can. J. Plant Sci. 69:39-48, 1989.

Miscellaneous Papers

M145 KRUGER, J.E.
Biochemistry of Preharvest Sprouting in Cereals.
In: *Preharvest Field Sprouting in Cereals*:61-84, 1989.

M152 COOKE, L.A., LABERGE, D.E.
Barley Nobody Malts.
Tech. Quar. MBAA 25:36-40, 1988.

Chapters in Books

J.E. KRUGER and G. REED. Enzymes and Color.
In: *Wheat Chemistry and Technology* (Third Edition), Vol. 1, 441-500,
published by the American Association of Cereal Chemists, St. Paul, Minnesota, 1988.

J.W. DICK and R.R. MATSUO. Durum Wheat and Pasta Products.
In: *Wheat Chemistry and Technology* (Third Edition), Vol. 2, 507-547,
published by the American Association of Cereal Chemists, St. Paul, Minnesota, 1988.

R.R. MATSUO. Evaluation of Durum Wheat, Semolina and Pasta in Canada.
In: *Durum Chemistry and Technology*, 249-261,
published by the American Association of Cereal Chemists, St. Paul, Minnesota, 1988.

Book Review

R.R. MATSUO. Review of *The Alveograph Handbook*
(published by the American Association of Cereal Chemists, 1987)
for Can. Inst. Food Sci. Tech. J. 21(5):468, 1988.

Other Publications

NIIHARA, R., MATSUO, R.R., YONEZAWA, D.
Effect of Fatty Acids on the Quality of Spaghetti of Varying Protein Content.
Nippon Shokuhin Kogyo Gakkaishi 35(3):173-180, 1988.

Periodicals

Sixty-First Annual Report. 1987-88 Report of the Grain Research Laboratory.

Cargo Bulletins

Red Spring Wheat editions are published in an English-French-German-Spanish version and an English-Chinese version (suffix "C").
Amber Durum Wheat editions are published in an English-French-German-Italian version.

242 Quality of Canadian Grain Exports 1987-88, Red Spring Wheat, second quarter (Nov. 1 to Jan. 31)

243 Quality of Canadian Grain Exports 1987-88, Amber Durum Wheat, first and second quarters (Aug. 1 to Jan. 31)

244 Quality of Canadian Grain Exports 1987-88, Red Spring Wheat, third quarter (Feb. 1 to Apr. 30)

245 Quality of Canadian Grain Exports 1987-88, Red Spring Wheat, fourth quarter (May 1 to July 31)

246 Quality of Canadian Grain Exports 1987-88, Amber Durum Wheat, third and fourth quarters (Feb. 1 to July 31)

- Quality of Canadian Canola and Flaxseed Cargoes, 1987-88 Crop Year

247 Quality of Canadian Grain Exports 1988-89, Red Spring Wheat, first quarter (Aug. 1 to Oct. 31)

Crop Bulletins

174 Quality of Canadian Wheat 1988

- Quality of Western Canadian Canola and Flaxseed 1988 - Preliminary Report

175 Quality of Western Canadian Canola 1988

176 Quality of Western Canadian Flaxseed 1988

177 Quality of Canadian Soybean 1988

Publications and Durum Wheat Research

Seated (L to R): Mike Lymych, Sheila Beauchemin, Bob Matsuo, Carol Rebizant, Roger Daniel. Standing (L to R): Harvey Zimberg, Adeline Armstrong, Diana Chance, Jeff Babb, Bob March.

STAFF

K.H. Tipples, *B.Sc., Ph.D.*	Director
N.H. Barchuk, *B.Sc.*	Special Assistant to the Director *(Research)*
D.J. Ramsay	Secretary

Administration

N.L. Morgan	Assistant Director *(Administration)*
K.A. Tait	Office Manager
E.F. Anderson, M.C. Cyr, G.A. McLean, M.J. Pewarchuk*, A.M. Robertson	Clerks
S.L. Wiebe	Word Processing
C.R. Bunston, M.E. Lick, *Dipl. A.A.*	Secretaries

Analytical Development and Services

P.C. Williams, *B.Sc., Ph.D.*	Research Scientist
J.A. Panford, *B.S.A., M.Sc.*	Chemist
W. Podolak*, P.A. Starkey***	Senior Technologists
C.J. Ashley, H.M. Cordeiro, *Dipl.T.*, F.Y. Lim, L.G. Oneschuk, C.M. Panting, D.C. Sobering, *B.Sc.*, R.K. Brady, D.L. Parent, *Dipl.T.*, W. Aarts, T. Boomer, T. Harnden, *B.Sc.*, G.R. Hennessey, D.S. Saydak, *B.S.A.*, J.P. Yau, *B.Sc., M.Sc.*	Scientific Support
S. Stevenson, M. Al-Rudha*, M. Budzinsky*, S. Harborne, D. Heide	Casual Assistants

Basic Barley Research

A.W. MacGregor, *B.Sc., Ph.D.*	Research Scientist
J.E. Morgan, *B.Sc.*	Chemist
L.G. Dushnicky, *B.Sc.*	Senior Technologist
S.W. Schroeder, *B.Sc.*	Scientific Support
S. Deleau**, R. Roscoe	Casual Assistants

Breadmaking Research

R.H. Kilborn*	Senior Technologist
E.J. Gander, F.G. Paulley, L.H. Pelletier	Scientific Support

Breadwheat Quality Studies

K.R. Preston, *B.Sc., M.Sc., Ph.D.*	Research Scientist
B.C. Morgan, *B.Sc.*	Chemist
E. Mydlo, G.T. Kawamoto, *B.Sc. (Agric.)*, L.W. Minty, E.D. Lysenko, *B.P.E.*, I.H. Phillips, *B.Sc.*, C.K. Taplin	Scientific Support
T. Lequier**	Casual Assistant

Cereal Protein Research

B.A. Marchylo, *B.Sc., M.Sc., Ph.D.*	Research Scientist
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